Determining the Electric Field and Energy Flux in the Sun's Atmosphere
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The electromagnetic energy flux (or "Poynting Flux") through the Sun's atmosphere, which measures the flow of energy from the Sun's interior into the atmosphere and the heliosphere, depends on both the magnetic field vector, which can now be routinely measured with the HMI instrument on NASA's SDO Mission, and the electric field, which cannot currently be measured.

However, for the first time, we can provide a good estimate for the electric field in the Sun's atmosphere by making use of one of Maxwell's equations – Faraday's Law – to use the observed time evolution of the magnetic field to find the electric field, and hence the Poynting flux, from measurements made by HMI. We have recently published a paper describing how this can be done in the Astrophysical Journal (ApJ **715**, 242, 2010). The Poynting Flux can then be estimated from the magnetic and electric fields.

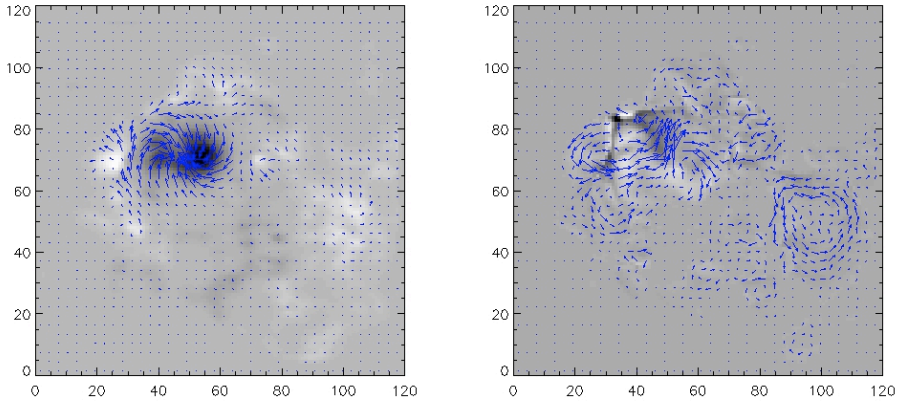

Figure 1 - The left panel shows a vector magnetogram of Active Region 8210 taken with theUniversity of Hawaii's IVM instrument. This dataset is described in Welsch et al. (2004).Arrows show the directions and amplitudes of B_x and B_y, and the background image shows the amplitude of B_z. The right panel shows a "vector electrogram" (a three-dimensional vector electric field map) of the active region, using the time evolution of B to estimate E. Arrows show estimated directions and amplitudes of E_x and E_y, while the background image shows the estimated amplitude of E_z. The example shown here displays E computed using the "variational" technique of section 3.3 of Fisher et al. (ApJ 2010, 715, p.242)

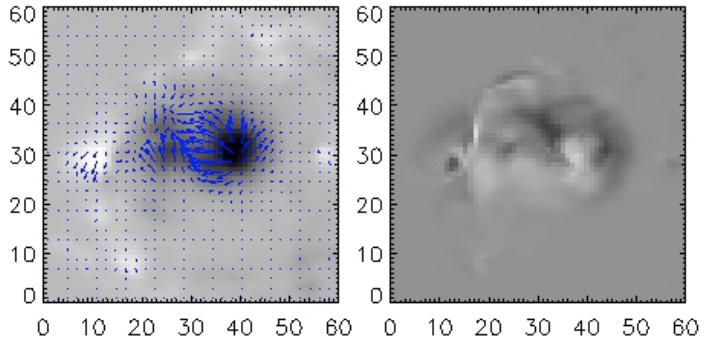

Figure 2 – Poynting Flux map (left panel, horizontal components, right panel, vertical components) corresponding to the magnetic and electric field vectors of Figure 1. The image is cropped to the regions of the strongest magnetic fields.